PEACE

NEWSLETTER No. 5

on hydrogen production

February 2025

Content

1. Editorial

We are proud to present this issue of the PEACE newsletter, marking significant milestones in the project's progress: we have just delivered two research reports (deliverables) to the Clean Hydrogen Partnership, summarizing our efforts and accomplishments over the past year and a half.

The first report, with a sensitive dissemination level, details the results of rigorous electrochemical cell component testing carried out at Eindhoven University of Technology (TU/e) and German Aerospace Center (DLR). These findings will guide the selection of substrates and membranes and inform the design of the electrochemical cell for the PEACE demonstrator.

The second report is closely linked, focusing on the design of the PEACE stack components. Materials Mates Italia (MMI) dedicated months to thorough testing, in-depth discussions, and overcoming technical challenges. Its report identifies the materials and technologies necessary for constructing the PEACE demonstrator stack.
We hope you find this issue both insightful and inspiring!

As we have just approached the end of another fruitful year of collaboration and innovation, I would like to extend my warmest wishes to you. May the year 2025 bring you joy, fulfilment, and, above all, PEACE.

Thank you for joining us on this exciting research journey!

PEACE project website

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2. About PEACE

“Pressurized Efficient Alkaline EleCtrolysEr” (PEACE) project is a research and innovation activity funded under the EU Horizon Europe programme by the Clean Hydrogen Partnership and coordinated by the German Aerospace Center (DLR). The PEACE project will deliver high-pressure alkaline electrolysis (AEL) technology which will substantially reduce hydrogen production costs. We will propose a new concept of hydrogen production with two-stage pressurization that will be demonstrated on an AEL system of more than 50 kW capable of operating at pressures exceeding 50 bar. The integration of advanced components, innovative design, and optimized operation strategies will be explored through modelling and experimental testing, ultimately aiming to demonstrate a system with impressive efficiency characteristics (see more on PEACE website).

Project members: German Aerospace Center (DLR); Materials Mates Italia (MMI); Eindhoven University of Technology (TU/e); Brandenburgische Technische Universität Cottbus Senftenberg (BTU); GRANT Garant (GG); The Hydrogen Chemistry Company (HyCC); Technical University of Denmark (DTU)

Fig. 1 PEACE Project Team (Feb. 2024), Source: PEACE project, (CC-BY-NC-ND 4.0)

2.1 THIRD PEACE PROJECT MEETING

In mid-September 2024, the PEACE project held its third all-hands project meeting. to assess the progress of PEACE research and innovation efforts, aiming to develop a highly pressurized alkaline electrolysis (AEL) technology. This technology is expected to reduce the cost of (green) hydrogen production and its subsequent utilisation.

One of the key aspects of the meeting was the intensive exchange of ideas, as the project prepared to achieve two major research targets in late November 2024: (1) the qualification of cell components, including substrates, diaphragms, and membranes; and (2) the design and production of stack components for high-pressure AEL operation.

The meeting was organized by the Coordinator, Dr. Fatemeh Razmjooei, Institute of Engineering Thermodynamics at German Aerospace Center (DLR), who provided a comprehensive overview of the goals met so far and the challenges that lie ahead. PEACE has successfully handed over eight deliverables to the Clean Hydrogen Partnership (the granting authority), all in accordance with the project plan.

Presentations of WP2 teams of TU/e and DLR offered a direct comparison of results from their electrochemical testing on cell/stack components. They presented preliminary findings, which led to an In-depth discussion on the performance of the related result. The high-performance benchmark of 1 A/cm2 at 1.8V is fulfilled. Tested separators demonstrated comparable and reasonable gas purity within a specific current density range. WP2 has geared up for final testing, with results to be summarised in a deliverable report by the end of November.

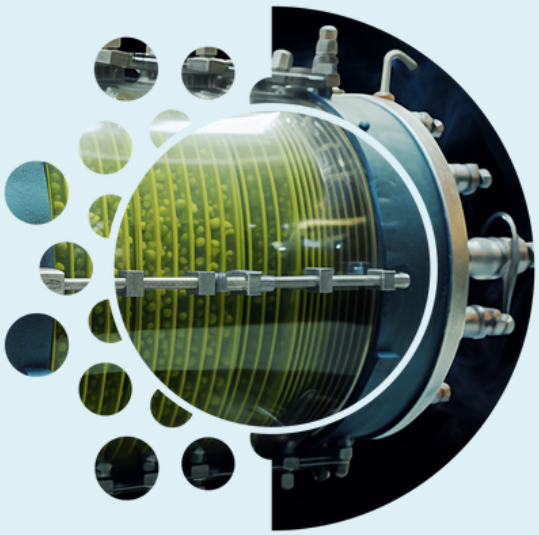
In WP3, MMI provided an update on the development and qualification of stack components. Their efforts included launching the operation of the gantry mill and optimizing the production of end plates for better pressure-to-weight performance. Gasketing issue were already resolved, and the full stack design has been progressing smoothly.

BTU, leading the WP4 and hosting the PEACE AEL stack demonstrator, presented the status of their stack readiness, with DEKRA Test and Pressure Certification recently achieved. The team also shared and discussed the Piping and Instrumentation diagram (P&ID) for the high-pressure setup.

The WP5 team at DLR has successfully developed simulation scenarios for the PEACE AEL system. They are currently working with the TEMPEST modelling framework to complete the PEACE electrolyser system (pressure vessel and other BoP parts). In parallel, they are defining operating strategies to ensure safe and efficient transitions between nominal and part load operation modes while maintaining high gas purity during partial load and rapid power changes (e.g. when renewable energy sources are involved).

Lastly, GG provided updates on the ongoing PEACE communication campaign. The PEACE website is regularly updated with news, and PEACE's active presence on social media (PEACE X and LinkedIn profile) has contributed to growing engagement and increasing the visibility of the project's impact.

In summary, the PEACE project is on track, with significant progress made towards its first scientific outputs, expected in the coming months.



2.2 FIRST MILESTONE ACHIEVED: CELL COMPONENTS QUALIFICATION REPORT DELIVERED

After more than a year of rigorous electrochemical cell component testing, the PEACE project has reached its first scientific milestone. In late November, researchers from Eindhoven University of Technology (TU/e) and German Aerospace Center (DLR) submitted their findings to the Clean Hydrogen Partnership (granting authority).

This research report marks an important step in the development of innovative high-pressure alkaline electrolysis technology, the cornerstone of the PEACE project's mission to reduce the levelized cost of hydrogen production.

Achieving top performance begins with optimizing the electrochemical process at its core - starting with the cell components. The stack and system design are pivotal to realizing the full potential of the pressurized PEACE electrolyser (demonstrator).

The recently delivered report focuses on the qualification of cell components. Its outcomes will guide the careful selection of substrates and membranes, as well as inform the design of a PEACE cell. Components qualified will undergo further testing and optimization before its final integration into the PEACE electrolyser stack design.

Cell design will be elaborated upon the report findings as to minimize contact resistances and reduce gas crossover which is assumed to be a major challenge for high pressure hydrogen production.

Stay with us as the final results of the cell components qualification are expected to be completed by 2025, setting the stage for the next phase of development and continued progress in the PEACE project.

2.3 PEACE STACK COMPONENTS DESIGN READY

In November, the PEACE project was busy with reaching its second scientific milestone: the design of its stack components. The target has been successfully met, following months of rigorous testing, discussions, and technical problem-solving sessions. A comprehensive research report, authored by Materials Mates Italia (MMI), has been finalized and once approved by the Clean Hydrogen Partnership it will be available on the PEACE project website.

This deliverable identifies all the materials and technologies required for constructing the PEACE demonstrator stack (50 kW / 30+ bar overpressure). The focus is on adopting scalable tools and widely available standard materials to lower the overall cost of the stack, including both its components and the associated workload.

Initially, a laboratory-scale cell was designed for material evaluation and leak tested under pressurized conditions (see Figure 2); this design was subsequently scaled up to a full-size model ready for the short stack assembly.

Fig. 2 PEACE Project Test Cell, Source: MMI (CC-BY-NC-ND 4.0)

To reach the PEACE Project Test Cell, MMI conducted extensive testing and reached key conclusions in various areas, including:

- Production tools (gantry mill)
- Materials for spacers (PEEK)
- Elastomers (EPDM)
- Bipolar plates and elastic elements
- Gasketing

In addition, Finite Element Analysis (FEA) simulations were performed to assess the compression resistance of the stack components (spacers, bipolar plates, and endplates). Computational Fluid Dynamics (CFD) simulations were also carried out to analyse the fluid dynamics within the cell (see Figure 3).

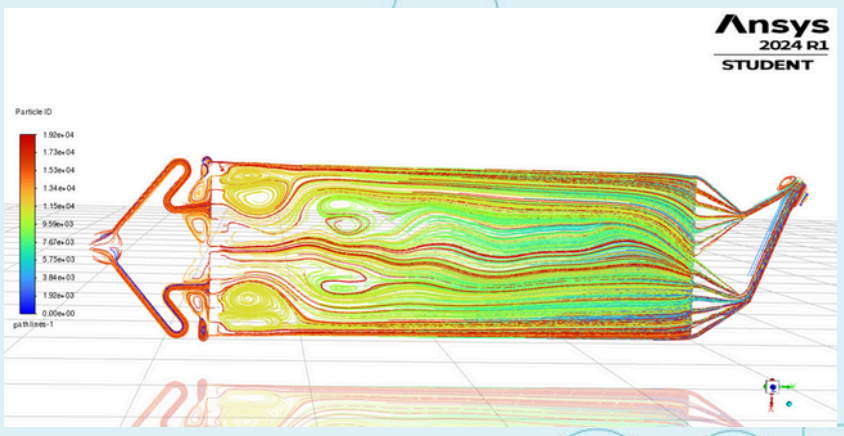


Fig. 3 Simulation of the flow inside the cell, Source: MMI (CC-BY-NC-ND 4.0)

Once the PEACE Project Test Cell was assembled, MMI carried out real measurements of performance for components such as elastic elements and O-ring gasketing (see the test bench image below).

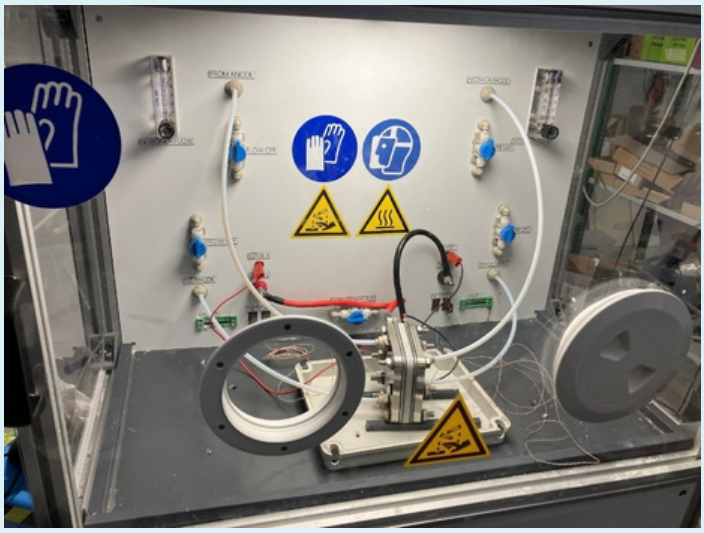


Fig. 4 MMI Test bench, Source: MMI (CC-BY-NC-ND 4.0)

Finally, the PEACE cell is now operational, and MMI is preparing for the first short stack assembly, where the identified technologies and components will be integrated into a life-size object.

2.4 PEACE PEDR UPDATE

PEACE has recently delivered to its granting authority, the Clean Hydrogen Partnership, the first update of its Plan for the Exploitation and Dissemination of Results (PEDR). The original PEDR was handed out in November 2023 (see its comprehensive presentation in the PEACE Newsletter#4). A periodical update was foreseen and accomplished in August 2024. Just to remind you that PEDR is a strategic document outlining how the project consortium will effectively communicate its activities and disseminate project results to various audiences. It also sketches the future exploitation and potential commercialization of the project outcomes.

The structure of the report stayed untouched with sections dedicated to C&D&E rules of the Horizon Europe prgoramme; PEDR target groups; PEDR tools; PEDR phases identification; Outlines of the Communication Plan, Dissemination Plan and Exploitation Plan, closed by Conclusions. The key amendments in the PEACE PEDR I Update can be summarised as follows:

PEACE Zenodo community

A Zenodo community was established with a potential to become a long-term and widely accessible platform for PEACE publications, datasets and other research outputs.

Communication and Dissemination Key Performance Indicators (KPIs)

A set of communication&dissemination KPIs were defined within the original PEDR. Its performance is continously monitored by the WP6 leader Grant Garant. The PEACE communication campaign built around the PEACE website and social media (X and LinkedIn) showed very positive results in the first year of its implementation. The PEACE LinkedIn profile attracted about 600 followers, demonstrating strong engagement and audience growth, far exceeding expectations. PEACE website performance has been developing well but its impact-boost is expected in later phases of the PEDR implementation with more results-oriented content optimization. The PEACE X profile shows promising progress but remains a supplementary tool to target general public audience.

The online campaign is supported by this PEACE quarterly Newsletter together with PEACE leaflets distribution and roll-up presentation at various hydrogen events in Europe. So far, the PEACE project has been displayed on European Hydrogen Week 2023, Hannover Fair 2024 or during the Summer Tour 2024 of Germany's Federal President Steinmeier at BTU Cottbus. Simultaneously, first PEACE results were reported about during Thijs de Groot's (Tu/E) speeches in the PtX Symposium in Aarhus or at the 1st Electrochemical Conversion National Symposium in the Hague. Saksham Pandey (Tu/E) presented a research poster on the ohmic resistance of alkaline electrolysers at GVNL-ECCM Graduate School 2024.

The PEACE project targets also university students through active incorporation of preliminary results into a MSc course on electrochemical engineering at TU/e.

Exploitation Plans for PEACE key results

The exploitation plan seeks to transform PEACE R&I actions into tangible societal benefits, particularly by reducing the levelized costs of hydrogen, thus stimulating demand for hydrogen and the hydrogen economy. The PEACE project will undertake scientific and commercial exploitation pathways for its key results . Results gained out of the PEACE project are planned to be developed further mainly by subsequent R&I activities, also due to the low TRL attained at the end of the project. Patenting is foreseen for some results. Detailed exploitation visions will be developed further to get a comprehensive exploitation strategy at the end of the project.

To sum up, the PEACE PEDR campaign is fully underway. If you are interested to take a deeper look into PEACE key communication & dissemination report, stay tuned as the updated PEDR will go online soon at the PEACE website.

Fig. 5 PEACE Project Consortium Members, Source: PEACE Project, (CC-BY-NC-ND 4.0)

3. Hydrogen News

DLR Authors' Article on flow-engineered three-dimensional electrodes for AEL

An interesting reading for all alkaline water electrolysis enthusiasts has recently been published in Nature Communication. A paper co-authored by experts from the Institute of Engineering Thermodynamics, German Aerospace Center (DLR) presents a PEM-like performing alkaline water electrolyzer, reaching a performance of 2 A·cm−2 at below 2 V cell voltage thanks to flow-engineered 3-D electrodes.

Article details

Title: Proton exchange membrane-like alkaline water electrolysis using flow-engineered three-dimensional electrodes

Authors: Fernando Rocha, Christos Georgiadis, Kevin Van Droogenbroek, Renaud Delmelle, Xavier Pinon, Grzegorz Pyka, Greet Kerckhofs, Franz Egert (DLR), Fatemeh Razmjooei (DLR), Syed-Asif Ansar (DLR), Shigenori Mitsushima, and Joris Proost

Journal: Nature Communications 15, 7444 (2024), https://doi.org/10.1038/s41467-024-51704-z

Source of the news

Second Hydrogen Bank auction has increased its budget to €2 billion

On November 18, 2024 the European Commission, alongside Spain, Lithuania, and Austria, has unveiled a major financial boost for renewable hydrogen development. Through the Auctions-as-a-Service scheme, part of the second European Hydrogen Bank auction, these three Member States will allocate some extra €700 million in national funds to support renewable hydrogen production projects located in their countries. Together with already announced €1.2 billion in EU funding, the total funding mobilised by the 'IF24' auction would reach about €2 billion. Projects selected under the 'IF24' scheme will be granted a fixed premium (pay-as-bid) on renewable hydrogen production for up to 10 years to bridge the gap between the cost of producing renewable hydrogen and the market price. The specific premium amount will be determined through a competitive bidding process.

Source of the news

Clean Hydrogen Partnership 2025 call for projects open

This news is not to be missed by all hydrogen value chain stakeholders: Clean Hydrogen Partnership has in mid-January opened its 2025 Horizon Europe call for advancing hydrogen innovation projects, worth €184.5 million. The call is addressing key topics such as: Renewable Hydrogen Production, Hydrogen Storage and Distribution, Transport Applications, Heat and Power , Cross-Cutting Activities, and not to forget, Hydrogen Valleys. All relevant materials and background presentations are available at the Clean Hydrogen Partnership website.

Summary information about this call to be found below in the Section 5 Hydrogen Project Funding Opportunities of this Newsletter and full details available on the *EU Funding & Tenders Portal*

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Source of the news

Hydrogen at stage at COP29

The 29th UN Climate Change Conference (COP29) was held in Baku (Azerbaijan) from November 11 to 22, 2024. The role of hydrogen in addressing climate change has been affirmed. The COP29 Hydrogen Declaration, a major initiative by the COP29 Presidency to unlock the potential of a global market for clean hydrogen and its derivatives was issued. The Declaration is supported by several UN bodies, as it aims to reduce greenhouse gas emissions and accelerate progress toward global climate goals. The declaration outlines priorities including demand creation, certification, financing, capacity building, and trade. It also calls on countries to include hydrogen in their national energy plans and to track progress at COP30. It calls for new measures to transport and store renewable energy and emphasizes hydrogen's potential namely as an energy carrier capable of decarbonising hard-to-abate sectors, such as heavy industry or transportation.

Source of the news

Inspiring reading on ohmic resistances in alkaline electrolysers

A new portion of food for thought for hydrogen enthusiasts represents a recent paper in Electrochimica Acta, co-authored by our TU/e colleague Thijs de Groot. An investigation of the increased ohmic resistances observed in zero-gap alkaline water electrolyzers provides you with insights of how to increase electrolyzer efficiency and enable operation at higher current densities.

Article details

Title: Elucidating the increased ohmic resistances in zero-gap alkaline water electrolysis

Authors: Rodrigo Barros, Mathy Kelleners, Lucas van Bemmel, Thijmen Van der Leegte, John Van Der Schaaf, Thijs de Groot

Journal: Electrochimica Acta, Vol. 507, https://doi.org/10.1016/j.electacta.2024.145161

Source of the news

4. Hydrogen Events

Hyvolution PARIS, 28-30 Jan., 2025, Paris (FR)

The 8th edition of this leading hydrogen trade show has just closed its gates with more than 550 exhibitors and 15,000 visitors along the hydrogen production chain. Hyvolution Conference hosted experts and international speakers to discuss the topics of Mobility, Industry, Financing, and Market Design. A summit of political leaders and international economic players in the hydrogen sector took place alongside. Not to miss the next edition of January 2026!

Event link

4th Annual World Electrolysis Congress, 10-13 Feb., 2025, Cologne (DE)

Maximising electrolyser performance, scaling up deployment, electrolyser integration, innovating power supply, policy updates, or project financing – these topics will be on the table at the World Electrolysis Congress. Two days of conference will be joined by a masterclass day including electrolyser design, balance of plant, or operational safety issues.

Event link

H2 Forum Berlin, 4-5 March, 2025, Berlin (DE)

This conference and exhibition event will showcase real-world projects and highlight success stories of the hydrogen sector. It will delve into the regulatory landscape and market strategies while introducing innovative, cutting-edge technologies.

Event link

Hannover Messe, March 31 – April 04, 2025, Hannover (DE)

The world's most important industrial trade fair will host more than 500 exhibitors from the hydrogen and fuel cell sector. Institute of Engineering Thermodynamics of the German Aerospace Center (DLR) as well as the Chair of Thermal Energy Technology of the BTU will be there, too - let's meet the PEACE project in the Hall 13!

Event link

5. Hydrogen Project Funding Opportunities

Innovation Fund 2024 Net Zero Technologies – Pilot projects

A call (INNOVFUND-2024-NZT-PILOTS) for highly innovative lump sum projects focusing on validating, testing and optimising disruptive, deep decarbonisation solutions in all sectors eligible for Innovation Fund support. A single-stage call with a budget of EUR 200 000 000 is eligible only for projects with a capital expenditure above EUR 2 500 000.
Deadline date: 24 April, 2025

Innovation Fund 2024 Net Zero Technologies – Clean-tech manufacturing

This call (INNOVFUND-2024-NZT-CLEAN-TECH-MANUFACTURING) supports construction and operation of manufacturing facilities which will produce components for renewable energy (photovoltaics, wind power etc.), for electrolysers and fuel cells, for energy storage solutions as well as for heat pumps. Innovation must be demonstrated in products and/or production processes. A budget of EUR 700 000 000 will be dedicated to selected projects with capital expenditure above EUR 2 500 000.
Deadline date: 24 April, 2025

Innovation Fund 2024 Net Zero Technologies – General Decarbonisation

Three topics under this call (for Small-Scale Projects, Medium-Scale Projects and Large-Scale Projects) are to support and advance innovative low-carbon technologies and processes to mitigate climate change in specific sectors (see Annex I and III of the EU ETS Directive 2003/87/EC). Projects with innovative low-carbon technologies and processes, as well as carbon capture and storage activities and innovative renewable energy activities are to be supported. Hydrogen use in industry (i.e. hydrogen use as an energy carrier, reducing agent, or feedstock) and hydrogen production projects with a demonstrated sufficient degree of innovation can also be funded under these topics.

Scale of the project is derived out of its capital expenditure: large-scale (above EUR 100 000 000); medium-scale (above EUR 20 000 000 and up to EUR 100 000 000); small-scale (above EUR 2 500 000 and up to EUR 20 000 000).

Deadline date: 24 April, 2025

Clean Hydrogen Partnership 2025 Call (HORIZON-JU-CLEANH2-2025)

This immense call for proposals, with an indicative total budget of EUR 184.5 million, encompasses 19 topics, mostly research and innovation actions in the given areas:

Renewable Hydrogen Production

- HORIZON-JU-CLEANH2-2025-01-01: Improvements in lifetime and cost of low temperature electrolysers by introducing advanced materials and components in stacks and balance of plant
- HORIZON-JU-CLEANH2-2025-01-02: Improved lifetime and cost of high-temperature electrolysers by introducing innovative materials and components in stacks and BoP
- HORIZON-JU-CLEANH2-2025-01-03: Scale-up and Optimisation of manufacturing processes for electrolyser materials, cells, or stacks
- HORIZON-JU-CLEANH2-2025-01-04: Efficient electrolysis coupling with variable renewable electricity and/or heat integration
- HORIZON-JU-CLEANH2-2025-01-05: Innovative co-electrolysis systems and integration with downstream processes
- HORIZON-JU-CLEANH2-2025-01-06: Innovative hydrogen and solid carbon production from renewable gases/biogenic waste processes
- HORIZON-JU-CLEANH2-2025-01-07: Towards exploration and evaluation of European natural hydrogen potential

Hydrogen Storage and Distribution

- HORIZON-JU-CLEANH2-2025-02-01: Development of mined, lined rock cavern for gaseous hydrogen storage
- HORIZON-JU-CLEANH2-2025-02-02: Development of cost effective and high-capacity compression solutions for hydrogen
- HORIZON-JU-CLEANH2-2025-02-03: Demonstration of scalable ammonia cracking technology

Hydrogen End Uses: Transport Applications

- HORIZON-JU-CLEANH2-2025-03-01: Configurable Fuel Cell Powertrain for Non-Road Mobile Machinery
- HORIZON-JU-CLEANH2-2025-03-02: Scalable innovative processes for the production of PEMFC MEAs
- HORIZON-JU-CLEANH2-2025-03-03: Reliable, efficient, scalable and lower cost 1 MWscale PEMFC system for maritime applications

Hydrogen End Uses: Clean Heat and Power

- HORIZON-JU-CLEANH2-2025-04-01: Demonstration of stationary fuel cells in renewable energy communities

Cross-cutting

- HORIZON-JU-CLEANH2-2025-05-01: Simultaneous ionomer and iridium recycling
- HORIZON-JU-CLEANH2-2025-05-02: Understanding emissions of PFAS from electrolysers and/or fuel cells under product use
- HORIZON-JU-CLEANH2-2025-05-03: Knowledge transfer and training of civil servants, safety officials, and permitting staff to improve safety assessment and licensing procedures across Europe

Hydrogen Valleys

- HORIZON-JU-CLEANH2-2025-06-01: Large-scale Hydrogen Valley
- HORIZON-JU-CLEANH2-2025-06-02: Small-scale Hydrogen Valley

Deadline date: 23 April, 2025

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"Pressurized Efficient Alkaline EleCtrolysEr" (PEACE) is a research and innovation project funded under the EU **Horizon Europe programme** by the **Clean Hydrogen Partnership.**

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